

Sensitive Plant and Horsetail:

Roadside Plants with
Antibacterial Potential

Mauricio Esteban Sánchez

Chemical engineer, MSc in engineering, mauricio.sanchez@udea.edu.co

Diana María Trujillo

Chemical engineer, dmaria.trujillo@udea.edu.co

Process Simulation, Design, Control and Optimization Research Group (SIDCOP)
of the Chemical Engineering Department of Universidad de Antioquia.



The frequent appearance of strains of microorganisms with antibiotic resistance generates an increase in bacterial infections and diseases that are difficult to treat. This adds to the need to develop alternatives based on plant extracts to prevent and combat them.

Closed sensitive plant.
Photo: courtesy of the project.

Microorganisms are the most primitive and abundant beings that exist on Earth. They are found in air, water and soil; they actively participate in the functioning of biological systems and are in permanent interaction with humans, animals, plants and the environment they inhabit.

Germes are those microbes that harm human health: viruses, fungi, protozoa and bacteria, among which are *Escherichia coli* (*E. coli*) and *Staphylococcus aureus* (*S. aureus*). The former is found in the intestines of humans and animals, the environment and sometimes in untreated food and water. However, there is a variety that can cause severe gastrointestinal conditions, urinary tract infections, respiratory diseases and bloodstream infections in humans. *S. aureus* causes infections by penetration of the bacterium from the skin into deep tissues when skin, traumatic or surgical injuries occur. Such infections are usually suppurative and tend to produce abscesses. Due to its wide versatility, it can cause a broad spectrum of diseases, from minor skin infections to serious invasive infections such as osteomyelitis and bacteremia. It can also cause infections of the central nervous system, respiratory tract and urinary tract, not to mention toxic shock syndrome and gastrointestinal infections. Thus, it is evident that we are exposed to these microorganisms and their risks daily.

The antimicrobial property of substances extracted from some plants is of great importance in medical, cosmetic, food and pest control applications, among others. This property is attributed to compounds such as flavonoids, tannins, phytoalexins, pyrethrins, musanolones, terpenes and essential oils. These are known as secondary metabolites. Plants produce them through sequences of chemical reactions that occur in a specific order called secondary metabolism. Although these metabolites do not have vital functions, they serve as

protection from the sun's ultraviolet rays and as a defense against predators and pathogens. They also attract pollinating insects and vary with the plant's interactions with the environment.

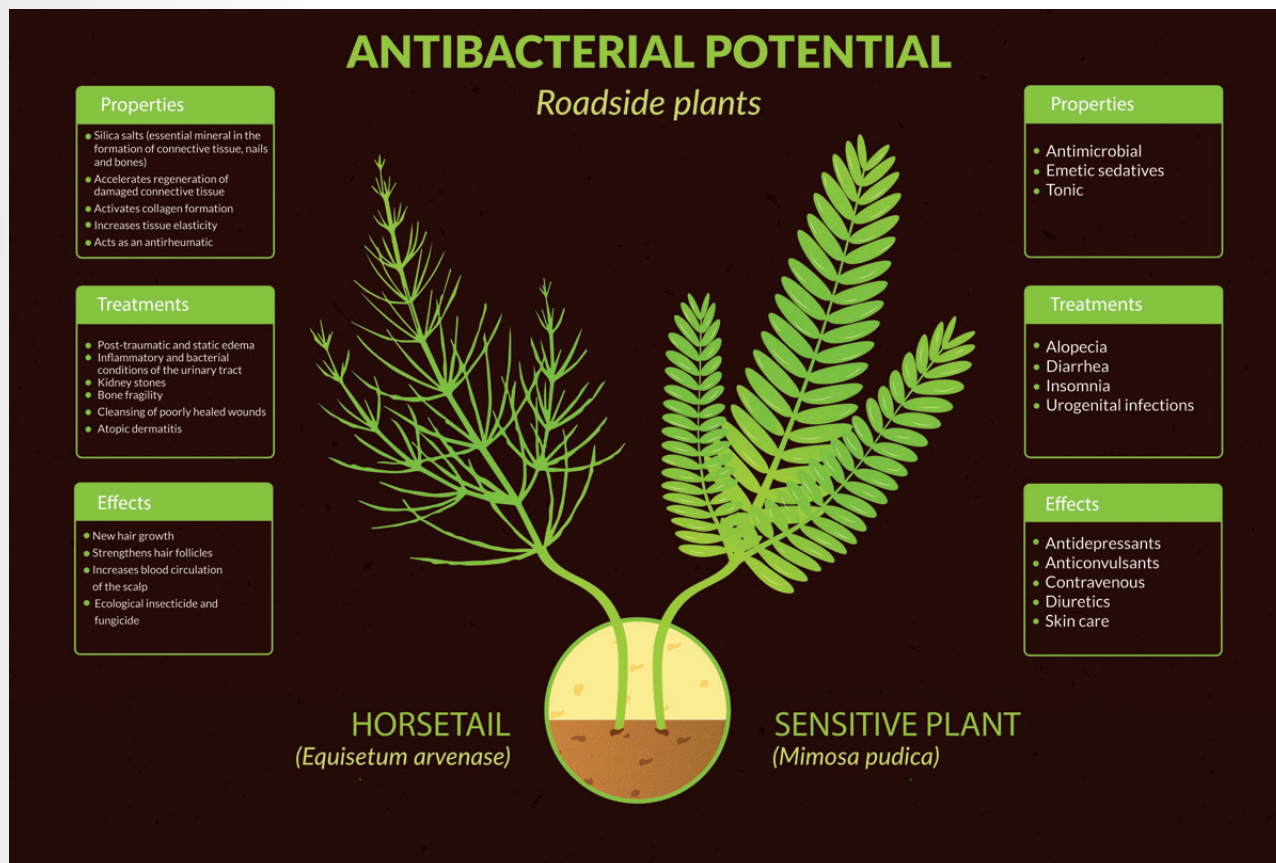
Historically, natural products have played an important role in improving human health and people's quality of life. Although the popularity of herbal medicine registered a marked decline after the introduction of chemical drugs used in conventional medicine, herbal medicines are once again gaining interest due to their natural, environmentally friendly attributes and the possibility of achieving true relief of disease without resorting to synthetic substances. Harmful side effects, the high cost of other forms of treatment and their limited availability for poor populations in remote areas are also reasons for the increasing use of herbal medicine, which has more than 3,000 years of tradition in countries such as India and China.

Colombia is a country with a great diversity of plant species, many of them considered weeds. However, their secondary metabolites have very beneficial properties for human beings, which generates an opportunity to generate high environmental, social and economic growth impacts.

Based on these opportunities, Universidad de Antioquia's SIDCOP group conducted a study with plants commonly known as horsetail (*Equisetum arvense*) and sensitive plant (*Mimosa pudica*) to determine whether ethanolic extracts and mixtures have antibacterial activity against strains of *E. coli* and *S. aureus*. Thus, we explored their potential to develop new high-value products with eventual applications in the agricultural, cosmetic, food and medical fields. This project focused on obtaining alcoholic extracts under specific conditions of temperature, alcohol/plant material ratio, contact time, plant origin and mixtures of different extracts at various compositions to determine their possible effect on inhibiting the growth of *E. coli* and *S. aureus* bacteria. We do not know of other studies that have reported the test conditions of this work.

For this study, the plant material was collected in the municipality of Gigante, Huila. It was dried, cleaned and ground. Then, the alcoholic ex-

traction of the dried material was performed by putting the dried leaves of each species in 96% ethyl alcohol for 72 hours at room temperature. The extracts were purified by heating to evaporate the solvent at atmospheric pressure (simple distillation) and in the presence of a vacuum (vacuum distillation). The extracts and their mixtures were subjected to qualitative phytochemical tests to identify secondary metabolites. Disc-plate antibiogram tests were performed to determine their potential to inhibit bacterial growth. Microdilution tests



The phytochemical screening of the ethanolic extracts of horsetail and sensitive plant verified the presence of secondary metabolites such as flavonoids, saponins, tannins and triterpenes.

in broth were also carried out to find the minimum inhibitory concentration against *E. coli* and *S. aureus* strains. The antibiotics gentamicin and clindamycin were used as positive controls to compare their effectiveness.

The results of this study determined the antibacterial potential of different extracts of *Mimosa pudica*, *Equisetum arvense* and their mixtures against *E. coli* and *S. aureus* for possible uses in the development of new products of high economic value in the pharmaceutical, food, nutraceutical, cosmetic and cosmeceutical industries. The tests showed that the mixtures of the extracts have an effect that enhances antibacterial activity since they showed the best results in growth inhibition for the two bacterial strains.

Based on the results, a very interesting exploratory window opens up for multiple applications of mixtures of sensitive plant



Cola de caballo.
Foto: cortesía del grupo



and horsetail extracts, which could contribute to the care of people and pest control in organic agriculture. Among the possible applications, we can mention:

- Preservatives for perishable foods, such as meats, processed cheeses and canned products.
- Easily digestible antibiotics to treat urinary, respiratory, gastrointestinal and skin infections; antibiotics unlikely to generate resistance.
- Preservatives for cosmetic products.
- Active compounds in cosmeceutical and nutraceutical products. X

Glossary

Simple distillation: thermal technique to separate mixture components.

Vacuum distillation: distillation process at reduced pressure that seeks to separate mixtures at low temperatures.

Disc-plate antibiogram: method used to determine bacterial sensitivity to antimicrobial agents.

Cosmeceuticals: industry that produces cosmetics with much more concentrated active ingredients than classic cosmetics, so they have a deeper penetration and require prescription and follow-up by a dermatologist or skin care specialist.

Nutraceutical: industry that produces food of animal or vegetable origin that benefits health and nourishes the body.

Strains: group of microorganisms of the same species from a specific sample or cell.

The authors would like to thank the Research Development Committee (CODI-PR19-02-07) for the financial support, and the Process Simulation, Design, Control and Optimization Research Group (SIDCOP) of the Chemical Engineering Department of Universidad de Antioquia for their support and technical assistance.